

The percentage of the fecal nitrogen which was composed of bacterial nitrogen was about the same in the periods of low- and high-protein ingestion.

There was no definite relationship between the excretion of fecal bacteria and that of urinary indican.

The ingestion of 5.23 grams of nitrogen *after* the fast was followed by an excretion of fecal bacteria which was only $\frac{1}{14}$ as great as when four times that amount of nitrogen was ingested *before* the fast.

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STUDIES ON WATER DRINKING. XVI. THE INFLUENCE OF DISTILLED WATER DRINKING WITH MEALS UPON FAT AND CARBOHYDRATE UTILIZATION.

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So far as we are aware, the only study of the utilization of fat and carbohydrate, as influenced by the ingestion of large volumes of water at meal time, is that reported by Mattill and Hawk.¹ In the tests cited in that report the subjects were young men and the water employed was a freshly prepared *softened* water. A somewhat better utilization was secured when large volumes of water were taken with meals. The variations, however, were not very marked except in the case of the fat utilization by one subject. In this case, the percentage utilization was increased from 94.3% to 96.5% as a result of high water intake.

The statement is frequently made that distilled water ingestion, because of the absence of electrolytes in such water, has a harmful influence upon the animal body. In this connection, Findlay² says that the ingestion of distilled water is followed by the swelling of the surface layers of the gastric epithelium and that "salts also pass out, and the cells may die and be cast off. This may lead to catarrh of the stomach." Harlow³ and Koeppe⁴ also believe that catarrh of the stomach may follow the ingestion of distilled water (iced). Nocht⁵ and Winkler⁶ report experiments which failed to demonstrate that any bad effect followed the drinking of distilled water. Spitta⁷ believes that we have, as yet, no definite

¹ *J. Am. Chem. Soc.*, 33, 1978 (1911).

² "Physical Chemistry and its Applications in Medical and Biological Science," London, 1905.

³ Quoted by Oehler.

⁴ *Deut. med. Wochschr.*, 1898, 624.

⁵ *Hyg. Rundschau.*, 1892, 273.

⁶ *Z. physikal. diät. Ther.*, 8, 671 (1905).

⁷ "Rubner's Handbuch Hygiene," Leipzig, 1911, 28.

solution to the problem as to whether the ingestion of distilled water is followed by harmful influences. Oehler,¹ on the other hand, has recently reported tests on white mice, which seem to indicate that the drinking of distilled water brought about hemoglobinuria. It is well established that the introduction of distilled water into the blood stream will bring about a hemoglobinuria of a transient character, but we are rather skeptical as to the possibility of *ingested* distilled water producing any such disorder. We are investigating this feature of the water drinking problem.

Description.

A complete description of the general plan of this series of experiments upon distilled water drinking with meals has been reported in a recent paper.² This experiment comprised three periods; (a) a preliminary period; (b) a copious water period, and (c) a final period. A uniform diet was maintained throughout the experiment.

The method used for the fat determinations was that of Kumagawa and Suto³ with the modification proposed by Inaba.⁴ In the determination of carbohydrates in the feces, a modification of Strasburger's method⁵ was employed. The method was exactly the same as that used in the former work by Mattill and Hawk,⁶ except that the reducing power of the solution was determined by Benedict's new quantitative method.⁷

The diet contained 155.4 grams of fat and 293.2 grams of carbohydrate per day, distributed among the various dietary constituents as indicated in Table I.

TABLE I.—COMPOSITION OF DAILY DIET.

Food.		Fat.		Carbohydrate.	
Dietary constituent.	Amount. Grams.	%.	Amount. Grams.	%.	Amount. Grams.
Milk.....	1200	4.0	48.0	5.71	68.5
Graham crackers.....	300	7.8	23.4	72.5	217.5
Butter.....	75	84.4	63.3	negligible	
Peanut butter.....	45	46.0	20.7	16.0	7.2
Total.....	155.4	...	293.2

Discussion of Results.

Fat Utilization—Subject C.—During the preliminary period, an average of 6 grams of fat was excreted daily (see Table II). The % of fat in the moist feces was 8.4. Water ingestion caused a decrease in these values.

¹ *Münch. med. Woch.*, 59, 50 (1912).

² Blatherwick and Hawk, *Biochemical Bulletin*, 3, No. 9, 1913.

³ *Biochem. Z.*, 8, 213 (1908).

⁴ *Ibid.*, 8, 348 (1908).

⁵ *Die Fäces des Menschen*, p. 173.

⁶ *THIS JOURNAL*, 33, 1978 (1911).

⁷ *J. Am. Med. Assoc.*, 57, 1193 (1911).

The data indicate that, during the water period, the feces contained a lower percentage of fat (8.21%) and that there was a lower output of fat per day (5.54 grams). The final period, in which the original dietary conditions obtained, showed 5.47 grams of fat excreted daily; the percentage of fat in the stools being still further reduced to 7.64%. The percentage utilization of fat during the three periods was 96.14, 96.43 and 96.50%, respectively. Water apparently caused a slightly better utilization of the ingested fat. However, the variations are within normal limits for utilization values.

TABLE II.—FAT EXCRETION—SUBJECT C.

Stool No.	Weight of stool.	Weight of dry matter.	Per cent. fat in fresh feces.	Weight of fat.
Preliminary Period (5 Days).				
1.....	43.5	10.19	8.23	3.58
2.....	43.5	11.60	8.25	3.59
3.....	60.5	18.37	8.94	5.41
4.....	73.5	21.87	8.05	5.92
5.....	136.0	37.66	8.46	11.51
Total.....	357.0	99.69	..	30.01
Average.....	71.4	19.94	8.40	6.00
Copious Water (5 Days).				
6.....	57.5	13.67	9.33	5.36
7.....	43.5	12.91	8.02	3.49
8.....	56.5	14.46	7.96	4.50
9.....	86.5	24.44	7.65	6.62
10.....	93.5	26.85	8.27	7.73
Total.....	337.5	92.33	..	27.70
Average.....	67.5	18.47	8.21	5.54
Final Period (5 Days).				
11.....	72.0	19.58	7.07	5.09
12.....	66.5	18.07	8.27	5.50
13.....	72.5	18.25	7.61	5.52
14.....	74.5	17.28	7.34	5.47
15.....	72.5	16.44	7.98	5.79
Total.....	358.0	89.62	..	27.37
Average.....	71.6	17.92	7.64	5.47

Subject V.—The daily output of fat during the preliminary period was 6.06 grams, 4.89% of the stools being composed of fat (see Table III). Under the influence of water, these values became 6.36 grams and 6.80%, respectively. In the final period, the daily excretion of fat was 5.04 grams and the percentage value 4.52. These values are considerably lower than

those obtained in the preliminary period before the high water ingestion, and also lower than those of the water period. It is probable that the ingestion of the large volume of water stimulated the activities concerned in fat utilization, but that the influence of the water was not felt at once but became slightly apparent in the after period. If we combine the water period and final period we find that during this ten-day interval the average daily fat lost by feces was 5.70 grams. This is an appreciable drop from the output of 6.06 grams per day, which we secured in the preliminary period. The utilization values for the three periods are 96.15%, 96.00% and 96.82%, respectively. The utilization value for the ten-day interval beginning with the water ingestion is 96.39%. Here, again, it may be considered that the variations in the utilization values fall within normal limits.

TABLE III.—FAT EXCRETION—SUBJECT V.

Stool No.	Weight of stool.	Weight of dry matter.	Per cent. fat in fresh feces.	Weight of fat.
Preliminary Period (5 Days).				
1.....	48.5	10.17	5.57	2.70
2.....	56.5	13.65	6.51	3.68
3.....	244.5	47.09	4.97	12.16
4.....	154.5	27.19	4.54	7.01
5.....	115.5	22.23	4.11	4.75
Total.....	619.5	120.33	..	30.30
Average.....	123.9	24.07	4.89	6.06
Copious Water (5 Days).				
6.....	56.0	10.65	5.42	2.94
7.....	75.5	16.90	6.73	5.08
8.....	44.5	7.05	7.06	3.14
9.....	120.0	26.75	7.03	8.43
10.....	171.5	38.60	7.12	12.21
Total.....	467.5	99.95	..	31.80
Average.....	93.5	19.99	6.80	6.36
Final Period (5 Days).				
11.....	162.5	32.97	4.98	8.10
12.....	124.5	23.89	4.63	5.76
13.....	56.5	11.90	4.27	2.41
14.....	214.0	34.52	4.17	8.92
Total.....	557.5	103.28	..	25.19
Average.....	111.5	20.66	4.52	5.04

Carbohydrate Utilization—Subject C.—The daily output of carbohydrate during the preliminary period was 1.39 grams (see Table IV). Under

the influence of distilled water ingestion this value became 1.29 grams, whereas the value for the final period was 1.13 grams. The percentage utilization was practically the same for each period, the actual figures being 99.52%, 99.56% and 99.62%, respectively for the three periods of the experiment.

TABLE IV.—CARBOHYDRATE EXCRETION—SUBJECT C.

Stool No.	Weight of stool.	Weight of dry matter.	Per cent. carbohydrate in fresh feces.	Weight of carbohydrate.
Preliminary Period (5 Days).				
1.....	45.5	10.19	1.94	0.84
2.....	43.5	11.60	1.94	0.84
3.....	60.5	18.37	2.01	1.22
4.....	73.5	21.87	1.84	1.35
5.....	136.0	37.66	1.97	2.68
Total.....	357.0	99.69	..	6.93
Average.....	71.4	19.94	1.91	1.39
Water Period (5 Days).				
6.....	57.5	13.67	1.60	0.92
7.....	43.5	12.91	1.57	0.68
8.....	56.5	14.46	1.93	1.09
9.....	86.5	24.44	1.95	1.68
10.....	93.5	26.85	2.19	2.06
Total.....	337.5	92.33	..	6.43
Average per day....	67.5	18.47	1.92	1.29
Final Period (5 Days).				
11.....	72.0	19.58	1.66	1.20
12.....	66.5	18.07	1.91	1.27
13.....	72.5	18.25	1.83	1.33
14.....	74.5	17.28	1.57	1.17
15.....	72.5	16.44	0.97	0.70
Total.....	358.0	89.62	..	5.67
Average per day....	71.6	17.92	1.59	1.13

Subject V.—In this case, the daily output of carbohydrates before the water period was 1.44 grams, 1.30 grams were excreted daily during the period of water ingestion, and 1.32 grams daily in the final period (see Table V). Here, again, the actual percentage utilization of the carbohydrate of the diet was the same in each of the experimental periods; the data indicating that 99.51% of the ingested carbohydrate was utilized during the preliminary period, 99.56% during the time of high water ingestion and 99.55% in the final period.

TABLE V.—CARBOHYDRATE EXCRETION—SUBJECT V.

Stool No.	Weight of stool.	Weight of dry matter.	Per cent. carbohydrate in fresh feces.	Weight of carbohydrate.
Preliminary Period (5 Days).				
1.....	48.5	10.17	1.01	0.49
2.....	56.5	13.65	1.54	0.87
3.....	244.5	47.09	1.10	2.69
4.....	154.5	27.19	1.13	1.74
5.....	115.5	22.23	1.24	1.43
Total.....	619.5	120.33	..	7.22
Average.....	123.9	24.07	1.17	1.44
Water Period (5 Days).				
6.....	56.0	10.65	1.07	0.60
7.....	75.5	16.90	1.61	1.21
8.....	44.5	7.05	1.50	0.67
9.....	120.0	26.75	1.40	1.68
10.....	171.5	38.60	1.36	2.33
Total.....	467.5	99.95	..	6.49
Average.....	93.5	19.99	1.39	1.30
Final Period (5 Days).				
11.....	162.5	32.97	1.28	2.08
12.....	124.5	23.89	1.06	1.32
13.....	56.5	11.90	1.39	0.79
14.....	214.0	34.52	1.13	2.42
Total.....	557.5	103.28	..	6.61
Average per day...	111.5	20.66	1.18	1.32

The utilization values for the two subjects for each period of the study are summarized in Table VI.

TABLE VI.—UTILIZATION OF FAT AND CARBOHYDRATE.

Period.	Subject C.		Subject V.	
	Fat. %.	Carbohydrate. %.	Fat. %.	Carbohydrate. %.
Preliminary.....	96.14	99.52	96.15	99.51
Water.....	96.43	99.56	96.00	99.56
Final.....	96.50	99.62	96.82	99.55

Summary.

Two young men were maintained upon a uniform diet, and the effect of the copious ingestion of distilled water with meals upon the utilization of the ingested fat and carbohydrate determined. The utilization of these nutrients was apparently uninfluenced by the drinking of large volumes of water at meal time.